existed for hundreds of years. I have already pointed out that the richer classes meet the difficulty by living in hotels and service flats where, owing to the greater bulk of the tasks to be performed, it is worth while to install and use machinery for preparing foods, washing-up utensils and for laundry and cleaning work of all kinds. The middle and operative classes cannot, however, live thus. I envisage them living in blocks of flats where every operation and task that can be done mechanically (which means electrically) is so carried out in spacious and convenient kitchens, laundries, sculleries and nurseries. These will be well lit, well ventilated, will be furnished with musical and ultra-violet light equipment (the latter for use in the winter) and will be worked under skilled management by the residents in the apartment house. Thus in living-rooms with central heating and electric fires for local heat, only a minimum of family work will be done. What a gain in health and comfort! I have estimated that a woman who now works almost continuously all day and every day would only need to put in the equivalent of 2 days' work each week in such an organized home. I earnestly suggest that women who are thinking and working to face modern domestic problems should give such a plan their serious consideration.

I have been told by women with whom I have discussed this plan that it would not work; that the task of sorting out the crockery belonging to the different apartments, the objection among the less educated to eating foods chosen from a common and perhaps rather standardized menu, the inefficiency of many of the women and their incapability of working on organized tasks and with mechanical apparatus, would give rise to insuperable trouble. My answer is that at the beginning the scheme should be applied to young and modern middle-class people, the people who are prepared to adapt themselves to a new regime in order to gain the leisure for other than domestic occupations, and who dislike the obviously inefficient methods of the unitary home or flat. If once it took on in such a stratum of society the idea would automatically spread downwards bit by bit, particularly to those families where the women are working, or have worked, in a factory.

A way out must be found; the single domestic servant living in a house where she is in a class apart cannot, in my opinion, be perpetuated. As I picture it, the domestic work would be done under the conditions which women like in factory life, and they would feel that they were working for themselves. Thus whilst we realize that our immediate task is the adaptation of what Faraday made possible to the electrical mechanization of homes as they are, let us look forward another step to the mechanized home as it may be in the future.

COMMUNICATIONS.

By Sir OLIVER LODGE, D.Sc., F.R.S., Honorary Member.

How can I tell anything about communications to a body which made electric communication possible? The Institution started as the Society of Telegraph Engineers. Its members were responsible for the actual business of laying down lines and trying out different apparatus and methods, until they reached the perfection which everybody is aware of to-day. They must know much more about the subject than any one individual possibly can. The only thing I can do is to talk to the lay or non-engineering part of my audience and call their attention to the remarkable feat of harnessing the ether for the purpose of transmitting intelligence. For that is what is done, whether we use a wire, a cable, or what is called the air.

Wireless telegraphy, now that we understand it, is really the simplest kind of communication. We make a disturbance in the ether at one place, leave it to spread out in all directions, as it inevitably must, and as all radiation does, with the speed of light; and then, at any number of distant stations, we arrange a wire or a coil to pick up these ether waves. The electrical stimulus thus generated is supplied to a rectifying and transforming device, which converts it into the mechanical vibrations of low frequency that we term " sound." That sound is applied to the ear, where the message is interpreted. whether it be in the code called morse or the other more familiar code called language.

I fancy people are under the impression that in wireless communication sound waves are shot off from a sending station and detected at a receiving station. That is an entire misapprehension. No sound waves could travel the enormous distances that ether waves travel; they would be wiped out long before they arrived; they would take a long time on the journey, and the process—even if it were feasible—would be exceedingly inferior. Sound is a vibration of matter, and matter has many imperfections. Sooner or later its energy turns into heat, and the sound is obliterated. The ether has no imperfections. Ether waves never generate heat while they are in the ether: they do, however, generate it when they are absorbed by a material object, especially by what is called a black body. Then they turn into heat; the energy thus becomes stationary and ceases to travel.

The old semaphore system of signalling used the ether as the means of transmitting a message; the motion of the arms up and down was seen by a telescope at a distance. The information travelled as light; the code was, of course, conventional and had to be interpreted by the receiver: but so it is in all cases. Another mode of etheric transmission is by the heliograph, where the rays of the sun or of an artificial light are reflected intermittently in a given direction by a mirror, which is tilted so as to give long and short signals. The heliograph has been much used, especially for war signalling, but it necessitates an uninterrupted line of vision between sender and receiver. This type of signal has the advantage of going in a definite direction, thereby concentrating the energy along a certain path, so that if the air is transparent there very little energy is lost by the way. The air is not always transparent, however, and a small trace of fog will interrupt communication by means of the heliograph. Waves of light are very easily absorbed by matter, and quenched.

I hear it said sometimes that sound or light once produced will go on careering through space, so that it can be detected at a distance any time afterwards. For sound waves that is untrue. Sound is wholly a vibration of matter, and cannot travel through empty space. Every sound produced in the course of history has adhered closely to the earth, and has long been obliterated. But there is a sense in which etheric vibrations continue; so that, though an occurrence cannot be heard, it can be seen, provided the light has got clear of matter and escaped into the vacuous region between the worlds, where it will continue unabsorbed and unaltered, though diffused. Any disturbance that has been put into the ether may be regarded as permanent, and its message, whatever it is, is conveyed, so that a sufficiently sensitive detector can read its message billions of miles away. This is exactly how we get information about the happenings on the stars, and even about the chemical constitution of those bodies. The receiver in such cases for the most distant bodies has to be a large telescope to collect the light, and then an instrument such as a spectroscope for analysing it and deciphering its message.

Light is emitted as the result of an occurrence in the constitution of the atoms. Our idea at present is that a planetary electron inside the atom drops from one orbit to another and thereby emits a flash of radiant energy, which has a frequency of vibration directly proportional to the energy. The flash gives us information as to the kind of drop that generated it, no matter how far off the sending station was. In some cases the radiation is so much diluted by the spreading-out, inevitable when it travels out in all directions, that the eye, though extremely sensitive, is unable to detect it. In such cases we use a chemical detector called a photographic plate. The eye can either see in a fraction of a second, or it cannot see at all. It does not accumulate energy. The process of seeing is not a continuous process: if it were, it would be very awkward; for then, having looked at an object, we should see nothing else for a long time afterwards: whereas in fact we can look away and see other things immediately. The impression only persists for about $\frac{1}{10}$ sec., and is then wiped out; unless it is so bright that it causes temporary damage to the eye, which is called a " dazzle." This effect is not produced by looking at faint objects. A photographic plate, however, has the power of accumulating the impression for hours together if turned always towards the same spot, and thus in the long run it becomes much more sensitive than the eye. This is the way in which we learn about the distant nebulæ far beyond the confines of our stellar system; this is how we learn of what matter they are composed, what is their physical state, whether they are revolving, and how fast they are moving away from us. For, strange to say, they nearly all are moving away from us, and this has led to the extraordinary idea that the universe is expanding —getting bigger. This matter, which is to be discussed by the British Association, is one on which I for one have no wish to dogmatize, nor even to express a considered opinion. We must leave that mainly to the astronomers. I only want to emphasize the fact that communications are not limited to the earth, and that we owe to etheric waves all the information which astronomers have received and studied and tell us of, about happenings in the universe at an incredible distance. Etheric transmission is perfect; the message is only enfeebled by distance, it is in no way obliterated or spoilt.

When we are dealing with terrestrial signalling, this is only partially true. The ether near the earth is incommoded, and, so to speak, loaded by the particles of matter it contains, and thus is not so perfect as it would be if it were entirely free in an absolute vacuum. Still, it is interfered with very little, and etheric signalling is by far the best method of communication yet discovered. When transmuted into sound and interpreted, the very tones of the voice can be heard just as when they were spoken, and music arrives unspoilt. The type of signal so far described spreads out in all directions, and can be picked up by anyone with a suitable receiver; so that the acoustic analogy of wireless signalling may be likened to shouting to a multitude of listeners at once. When we want to speak to a particular person at a distance, we employ a speaking-tube, the walls of which prevent the sound from spreading, and convey it to anyone who puts his ear to the far end of the tube. This kind of process can be applied to etheric signalling too. The plan is to lay a wire between sender and receiver; the wire will then react to the etheric waves somewhat like a speaking-tube acts with respect to sound waves. The theory of wired signalling is not so simple as that of etheric signalling. Historically it came first, but if it had come later it would have been regarded as an improvement, because it enables privacy to be obtained: it is not broadcast, but concentrated.

The answer to the question why a wire acts as a speaking-tube is not very simple. Most people have an idea that the wire conveys the impulse; but a metal wire is only a piece of matter, and has no power of transmitting ether waves. Directly they enter the wire, which they do laterally, they are dissipated and turn into heat. But this very fact, that some of the energy does enter the wire, enables it to act as a guide or director. The energy does not travel through the wire; it travels in the ether outside the wire. The laws of electric signalling, however, are such that the main part of the wave does not leave the wire and spread out in all directions, but travels near it, and can thus be received at the far end without much diminution of intensity. The theory of the transmission of ether waves by wire was made out by my friend and colleague at Birmingham, J. H. Poynting. Still, the waves in wired signalling are to some extent distorted; they do not all travel at precisely the same rate, and their different rates of travel cause the shape of a complex wave to be rather altered by the act of transmission. A sharp sudden pulse, in travelling a long distance, does not arrive as an equally sharp pulse: its corners are, so to speak, smoothed out; and assuming that the deciphering of the message depends upon receiving sharp dots and dashes there will be some difficulty in reading it if the features of the latter are partially obliterated, so that they arrive in a smoothed-out condition. This action is always to be expected when matter has any part in the transmission. It acts something like a coach-spring in smoothing out the jolts of the road. The chassis of a motor-car is constantly receiving sharp jolts, but partly by the tyres and mainly by the springs these are so smoothed out that the vehicle is only rocked gently. In land lines, where the wire is at some distance from the ground, this fact is not very prominent, and accordingly telephonic transmission can go on fairly well over any distance such as is found in the British Isles. But over a great continent like America, in speaking from New York to San Francisco, for instance, precautions have to be taken to avoid this smoothing-out or distortion or obliteration of the features of the waves. And if the space round about the wire is constricted, so that the earth is brought close to the wire on all sides, the obliteration and distortion become very noticeable.

This was one of the difficulties which the early cable telegraphists and engineers had to overcome. Lord Kelvin (Sir William Thomson) gave the first theory of cable signalling. He likened it to the transmission of a heat pulse along a rod. Imagine a long copper rod with a thermometer at the far end. A kind of signalling could be accomplished by applying a flame at the near end, then a piece of ice, and so on alternately. Pulses of heat would travel along the rod with no specified speed; the time taken before the thermometer responded would depend simply upon the sensitiveness of the thermometer. Heat pulses are not transmitted by the ether at all, but by matter. We cannot say at what rate they travel; it is a case of diffusion. That was the first theory of the telegraph cable, and to get anything like rapid signalling the thermometer would have to be excessively sensitive. Accordingly, the mirror galvanometer was invented for the purpose of detecting the slightest beginning of a rise in potential in a cable. It never was allowed to accumulate, but was promptly curbed by the application of an opposite pole of the battery, which had an effect analogous to that of a piece of ice applied immediately after the flame. Thus the cable never became appreciably charged beyond what was necessary. The tail end of each signal was cut off, so that another one could be sent quickly after the first: thus the discontinuous pulses necessary for signalling could be received (only a small amount of power being used) with a very sensitive detector. Lord Kelvin subsequently invented the siphon recorder, so that the signals could actually be made to record themselves upon a strip of paper while still extraordinarily weak. Although dots and dashes could be sent and were sent across the Atlantic in this way, it was hopeless to attempt to send the fluctuations caused by the human voice. It is impossible, in other words, to telephone through an Atlantic cable. The obliteration or distortion would smooth out the voice fluctuations into unrecognizable confusion. That is so to this day, and no one attempts to telephone through a long cable unless it is cut up into a series of short cables with automatic relays. But, as I have said, if the free ether is used for transmitting pulses, they arrive without distortion; therefore by wireless methods it is quite possible, and indeed has been made daily practicable, to telephone freely across the Atlantic, not with a cable, but in the openness of space.

Is there any way of overcoming, at any rate a part of, the distortion of a long line or of a cable? The genius of Oliver Heaviside supplied the answer. He worked out a theory of cable signalling more complete than Lord Kelvin's, taking into account some of the conditions which Lord Kelvin's theory had ignored. The first theory was only partial. It represented the truth in a way which helped engineers to achieve their ends; but it was not a complete theory. Heaviside's was complete. Lord Kelvin's took into account resistance and capacitance; Heaviside's also took into account self-induction and leakage.

Now the property of self-induction was not much known to the engineers of that day; and in so far as it was known it was only regarded as an obstruction. It contributed to impedance. The conception then was that putting self-induction into a cable was like introducing a lot of obstruction into it, a lot of inertia, and thus making it more difficult to signal than before. That was the first or common-sense view. Self-induction certainly does retard the signals and make them travel a little slower. Heaviside, however, showed that this effect would not be deleterious; although the signals would travel at something less than the speed of light they would move fast enough in all conscience. The speed of light would only be slightly modified, slightly reduced. The point was that with added self-induction the signals would have more inertia, they would travel on their way with greater vehemence, they would not easily be smudged out, smoothed over, and have their features obliterated. They would take a little longer on the journey, but they would arrive in recognizable form, especially if the cable were allowed to leak a little, a thing which had always been strenuously avoided. Leakage would weaken the signals, but it would help them to retain their features. Heaviside showed, in fact, that it was possible to have a "distortionless" cable which would not smooth them out at all. To get this there must be a certain proportion between the four quantities that he took into account, i.e. resistance, capacitance, self-induction and leakage.

Of these the real bugbear is resistance, which is wholly dependent upon the wire core of the cable, wholly a defect of matter. If we could find matter with no resistance, all the difficulties would disappear. But no such matter was known at the time of Heaviside's work, and even now the only matter that is known to have no resistance is a metal very near the absolute zero of temperature; a fact surprisingly discovered in the cryogenic laboratory at Leyden, where the great experimenter Kamerlingh Onnes was working with liquid hydrogen and helium and attaining extremes of cold. He found that a lead ring when cooled down to within a few degrees of absolute zero acquired what is known as the property of super-conductance, so that a current once started in that ring did not cease in a fraction of a second, as it commonly does when not maintained, but lasted for hours or even days. The current was, as it were, obeying the first law of motion; there was nothing to wipe it out. Ordinary currents are stopped by resistance, but if the metal has no resistance they continue.

If it were feasible to have the core of a cable at the absolute zero of temperature, telephony through it would be easy. But, so far as I see, this is impracticable, and we therefore have to obtain the same result by Heaviside's method of adjusting the four quantities; introducing self-induction, i.e. " loading " the cable, and thus approaching the distortionless condition. If, however, this condition were really satisfied, the signals would be so weakened that it would be difficult to detect them, even though they arrived unaltered in shape. A compromise has to be effected. Signalling through a cable can be improved even by adding a little self-induction; thus it became a question of how to achieve this end.

The first method, applied mainly to long land-lines, chiefly in America, was to introduce self-induction coils into the line at measured intervals, say, one to each mile. This was not a perfect plan, but it answered. The closer together the coils were put, the better. The method was taken up by Pupin, and various plans were tried. One way was to wind iron wire round the copper core, or to surround it by soft iron. The current passing through the core then generated a magnetic field in the iron, which increased its self-induction; for self-induction is entirely dependent upon the magnetic field. At first no iron was available of a type that would be very serviceable; but in the course of research it was found that an alloy of iron and nickel had what was called extreme permeability, even for very low magnetization. Thus the cable current, surrounded by a magnetic field, had its self-induction greatly increased and became almost distortionless. I am not aware that this plan has been adopted in actual Atlantic cables, but I understand that it has been used for shorter cables, and that morse signalling has been greatly improved thereby.

When duplex signalling is used, thus enabling messages to be sent in opposite directions at the same time, an artificial cable also has to be constructed to imitate the main cable, and the artificial cable is loaded with inductance coils at regular intervals. Thus the modern method of relay duplexing is rendered feasible; and, in so far as the signals are weakened by it, they can be automatically relayed on at intermediate stations. The signals thus reach their destination unimpaired; the added energy needed is contributed to the cable at the intermediate stations, the undistorted signals being strengthened and sent on automatically. This is a great thing for engineers to have accomplished, and is a remarkable example of the application of pure theory to practice. I believe that in America loaded telephone lines are constantly in use, and that the Americans have improved their line telegraphy very greatly. I do not suppose that it has yet reached perfection. Surely this is a direction in which further invention will be forthcoming.

So far I have been dealing with facts of which members of the Institution are doubtless fully aware. I have not indicated their connection with the work of Faraday, who, so far as I know, had no immediate connection with electric telegraphy. He provided the root principles; other people applied them. Land telegraphy owes a good deal to Wheatstone and his co-workers; cable telegraphy to Kelvin and the engineers of his day; while wireless methods have been developed by Marconi and his co-workers in a way that everybody knows. But all these things owe their origin, and their roots can be traced, to laboratory experiments and theory. Faraday's contribution lay in discovering the connection between electric and magnetic fields, and especially in his emphasis upon the importance of free space as contrasted with the matter in that space. He knew that an electric charge was not dependent upon the conductor on which it was distributed; that was the mere terminal of an electric field which existed all round the conductor and was really a phenomenon of the ether. So also a magnetic field, though mapped out by iron filings, was thought of by him as a great number of lines of force in the ether of space. Maxwell put these ideas into mathematical form, and laid down the foundation upon which we have built ever since. The whole theory of self-induction is due to Faraday's experiments; he discovered it, but he did not fully understand it. He found first a mutual induction between one coil and another through the space between them, and then he discovered the induction of a current on itself—a phenomenon which he first called " extra current." Thus to start a current in a wire we have to overcome the inertia of the space around that wire, while we are generating the magnetic field essential to the current, and this magnetic field tends to prolong the current when otherwise it would stop; to prolong it for a time depending upon the resistance of the wire. Thus the magnetic field behaves exactly like inertia; a massive body is hard to start, and once started is hard to stop; it is just like an electric current with plenty of magnetism attached to it, either by means of a coil or a sheath of iron or by both. Self-induction is another name for electromagnetic inertia, and it is this inertia which enables wireless waves to travel the distances they do.

There is one feature of these wireless waves, reference to which must not be omitted, though Faraday had nothing to do with it and he would have been very much surprised had it come to his notice. According to Hertz, who discovered the waves, generating them electrically and detecting them optically, they travelled in straight lines like beams of light. If this were so, they could not possibly reach America or the antipodes; for to do it they would have to travel in circles. In 1901 Marconi found that they did so travel, and mathematicians later showed why. FitzGerald, Heaviside, and Kennelly all suspected the existence of an upper conducting region of the atmosphere where the rarefied gas was ionized by the sunlight, electrons being shot off from the atoms, and the air at that level becoming a conductor—something like the rarefied air in a vacuum tube. Dense ordinary air is a non-conductor; empty space is also a non-conductor; but in between the lower atmosphere and space there must be air at all grades of rarefaction. Hence there must, at a certain elevation, be a conducting layer with free electrons and other ions in it. The effect of this layer was worked out mathematically both by Larmor and by Eccles. Eccles showed that in passing through electrified air, ether waves would travel rather more quickly than usual, so that a vertical ether wave reaching from the ground into the upper atmosphere would have its top travelling faster than its lower portion, to an extent depending upon the wavelength. He found that at a certain wavelength the tilt forward of the wave was just adapted to the curvature of the earth; for the upper part of a vertical wave has to travel faster than the lower if it is to move in a circle: it has farther to go. Hence certain wavelengths could be trusted to go right round the earth, by reason of the atmosphere in which they travelled.

This remarkable and surprising effect of the atmosphere had not at first been at all suspected. The fact that it is so enables wireless telegraphy to be worldwide, and will thus have the ultimate effect of making communication easy between one nation and every other, and so, let us hope, of increasing the friendliness of every part of humanity for every other part, so that they pool their resources and co-operate in overcoming the real difficulties which they encounter while living upon the surface of this planet. Whether the result will ever be that the whole earth will have one speech and one language, I do not know. There is, however, bound to be a trend in this direction, since communication is now so easy; and anyhow it is proverbial that when a man gets into touch with his neighbour, and realizes his point of view, they both become mutually more friendly, since quarrels arise chiefly from misunderstanding. Let us therefore hope that the method of world communication, introduced and developed by engineers, will have the effect—little anticipated by them—of welding the nations together and putting an end to fratricidal conflict and mutual destruction. To bring this about will require factors other than those which are controlled by the engineering profession; but we cannot always go on as in the past, spending our substance in apparatus for hostility and mutual destruction. Already there are signs of better times ahead; the nations are meeting together and trying to settle their differences by discussion and peaceful means; let engineers and everyone else recognize this as an outcome of their labours, and help it on to the utmost of their power.

In concluding the proceedings, the President, **Mr. Clifford C. Paterson, O.B.E.,** said:—

We have listened with the keenest interest to the addresses which have been delivered this morning. We heard others at Queen's Hall last evening, and they have all been inspired with a spirit of undisguised sincerity and of true homage to the man whom we meet to honour. We speak and act with the consciousness of having a great heritage, perhaps the greatest heritage man can have, the legacy of a great character and example.

Michael Faraday has made an irresistible appeal to men and women of all classes and all nations. Great as his discoveries are, they are not the greatest things connected with him. They were the inevitable results of his genius and character. Every student who has come to Faraday to learn of his work has stayed to do homage to the spirit which inspired him. The discoveries he made take on a new set of values when contrasted with the simple and modest honesty of his character, and the indomitable courage and pertinacity by which his genius for experimental investigation was made fruitful.

If Faraday had not found out the secrets of electric induction and established the broad theory which explained the phenomenon of the electric current, others coming after him would certainly have done so; although in this event the theory might have been evolved more slowly, and without that unerring directness which has made Faraday's electrical investigations a masterpiece in the art of experimental research.

Why then was it that both his contemporaries and succeeding generations held him and his work in such especial esteem? The answer to this question will, I think, lead us to the secret of his genius.

Faraday had a supreme reverence for truth, and a great love of science. He also had a deep love for humanity, so that it was his greatest delight to bring to others a realization of the science which to himself meant so much. In a period when men were feeling for isolated facts and theories in different parts of the field of science, Faraday's work was inspired by an unshakable faith in the essential unity of all physical phenomena. The determination to discover the nature of this unity dominated all his thoughts and governed his experimental projects.

Thus it was that he sought and found the interaction between magnetism and light, between magnetism and electricity. He sought to determine the nature of electric strain on dielectrics, the relation between electricity and gravity, between electricity and chemical action, and the interaction of magnetism and dielectrics.

The discoveries which have meant so much to humanity were the mere by-products of this search to establish the fundamental plan of things. The practical outcome of giving mankind new products and new powers, interested him but little compared with the smallest success in solving an enigma in physical or chemical science.

But others also have been inspired to a high degree with like ideals. That is true, and such men are always great and command the world's reverence. With Faraday, however, these ideals were implemented with a genius for experimental research and manipulative technique which had never been surpassed.

He planned each day his daily experimental campaign, and entered in his notebook what he hoped to prove. His expectations, though constantly justified, were frequently unfulfilled because his apparatus lacked the sensitiveness to detect the effect he had correctly surmised should be there. Thus this patient inquirer was frequently thrown off the scent. However, his implicit faith in the existence of a unifying plan underlying all physical phenomena inspired his persistence in renewed schemes of experimental inquiry.

Thus he found things out. He had the supreme satisfaction of establishing some important parts of the great plan he sought, and of demonstrating them to his own and future generations. Faraday idealized his work, as every true artist does. He lived for it and did not even ask from it a living.

The influence of Faraday upon scientific research in Britain has been profound, for he made ordinary people understand science and its objects. He made science appeal to the popular imagination, and science became a career—a respected occupation to which young men of brains and ability were drawn. Thus his work gave a great impetus to the growth of schools of experimental research in universities. His insistence upon facts and upon the need for complete experimental support before a theory might be even tentatively adopted, set a new standard of intellectual thoroughness. For Faraday came to a scientific world where the machinery for harmonizing speculation and experiment was in a relatively early stage of evolution. He started the development of mechanical theories to explain non-mechanical phenomena, a development which dominated modes of thought, particularly in England, for the rest of the nineteenth century. The fact that a new school of mathematical thought is now tending away from the older paths to which we have become so accustomed, does not diminish the practical contribution or the historical importance of Faraday's influence upon his generation. Intellectually and temperamentally Faraday was characteristically English, and the fact that his ideas never received such favour outside this country quite so thoroughly as they did within it has assigned to our nation an individuality of thought and has enabled it to make to world progress a contribution the effect of which can hardly be over-estimated. It was Faraday's example, indeed, which made the English mode of thought so important a factor in scientific progress.

By nature and inclination he was not one to engage readily or with dramatic success in the applications of research. He was not a Kelvin; and he shrank from the distractions and compromises of contacts outside his own experimental research work. The reason he gives for this is arresting. When asked to accept a post of great honour in the scientific world, he refused, and wrote to Prof. Tyndall to say " if I were to accept I would not answer for the integrity of my intellect for a single year." How many of us there are who accept positions of honour without a qualm of conscience, not even considering whether our intellectual honesty might be overtaxed!

I do not mention this in order to hold up for emulation Faraday's attitude to the world of industry and social activity, which pressed upon him from all sides. His attitude to it was essential for him and was a tribute to his strength of character. But I have a feeling that it may greatly have strengthened that tradition which, in the England of the subsequent 75 years, put pure research on a higher plane in public esteem than applied research, a tradition which has influenced adversely the number of men with really first-class brains who have devoted their abilities to the application of science and the results of scientific research to industry. We sometimes ask why it is that these islands have produced such outstanding pioneers in fundamental research, whilst other countries have been the first to gather the practical fruits of their work. I suggest, without wishing to dogmatize, that scientific and other university men in this country have esteemed the knowledge so much more highly than its applications that among our scientists there has existed in a greater measure than among those of other countries an intellectual reluctance to consider for themselves the difficult problems of the application of the new knowledge in the world around—or to divert, even a little, their experimental work into channels of practical utility.

Whatever views we may hold as to the advantages and disadvantages of this tendency, I do not think we can ignore the great influence which Faraday's example had in enhancing the repute of pure scientific research as a calling, in the eyes of the nation. And truly the harvest has been great.

We have met to-day to remind ourselves of some of those engineering applications which we owe more directly to Faraday's genius. What we shall never be able to estimate in tangible results are the labours of that great multitude of scientific workers who owed, and still owe, their inspiration to that great master.

And what of the future? If our visions for the future of electricity are to be realized, it will be according to the measure in which we produce men and women of the same sterling characteristics as Faraday, with the same ideals of self-effacing service. It will also depend, however, upon the extent to which we are able to carry practical research into every phase, new and old, of applied electricity. The progress of this movement in Britain during the last 10 years has been phenomenal, and it gives ground for assurance that electrical engineers have accepted the research man as a true partner with them in the heavy responsibilities they carry.

In concluding these proceedings and in re-viewing the successive pictures which the speakers of this morning have painted for us, I want to focus our attention upon the one thought which stands at the centre of all that has inspired them—the man Michael Faraday, his character and his influence. For, in the ultimate issue, it is through men and not through science that the world achieves its truest progress.